Western Digital.

Advanced Flash Storage Solutions for Automotive Applications

Key Advantages

- Decades of innovation in the flash memory industry
- Full portfolio of NAND flash products for automotive applications
- IATF 16949 certified on embedded automotive-grade products
- Automotive SPICE certified products
- Expertise in system-level architecture
- World-class fabs and manufacturing factories
- Close ties with global automotive OEMs and Tier-1 suppliers
- Partnerships with leading chipset vendors

AUTONOMOUS DRIVE

ADAS

NAV/INFOTAINMENT

ECOCKPIT

HD MAPPING

EVENT/DRIVE RECORDERS

TELEMATICS & OTA

V2X COMMUNICATIONS

Driving Automotive Innovation

The automotive industry is going through a revolutionary stage — from the driver to the driverless vehicle — generating a whole new world of applications around safety, connectivity and entertainment. Among these applications, high-definition 3D maps, advanced driver-assist systems (ADAS), autonomous computers, AI databases, data recorders, enhanced infotainment, over-the-air updates, and V2X all require on-board data storage. While the cloud is an important component for analyzing data to improve algorithms and databases, it is not sufficient to meet the needs of real-time edge computing.

Western Digital enables Automobile OEMs and Tier-1 suppliers to create highly reliable systems for their customers.

Providing a Complete Data Storage Solution

From the automobile to the cloud, Western Digital has a complete portfolio of storage products to support current and future vehicle system requirements. Western Digital offers embedded edge storage and removable storage for various automotive use cases and data center solutions for capturing and analyzing massive amounts of data collected from vehicles.

Meeting Automotive's Stringent Quality Requirements

Western Digital automotive-grade flash products are IATF 16949 certified and AEC-Q100/Q104 compliant. In addition, these products are fully vertically integrated, designed in-house and manufactured on dedicated production lines at Western Digital's state-of-the-art manufacturing facilities. Lastly, automotive-grade products go through rigorous testing to ensure high reliability that is necessary for safety applications. This vertical integration enables Western Digital to have tight controls on every step of product development and manufacturing to achieve high-quality storage solutions. Western Digital also provides supply longevity to reduce costs of additional qualifications.

A Trusted Partner

Western Digital has been a storage solution supplier to the automotive industry since 2002 when it launched its first HDD for automotive. Since then, Western Digital has continued to invest in the industry, launching new products at a regular cadence with automotive-grade NAND flash products launching in 2015.

iNAND® Automotive Embedded Flash Drives

iNAND Automotive Embedded Flash Drives (EFDs) are designed to support the harsh environments, high reliability and quality required by the automotive industry. The automotive iNAND product portfolio supports both UFS and e.MMC interfaces in a small 11.5x13mm package with a wide range of capacities to provide automotive OEMs and Tier-1 suppliers with choices that best meet their needs.

UFS Embedded Flash Drive

The **iNAND AT EU552** and **iNAND AT EU312** embedded storage solution is designed to meet the demanding requirements for data-intensive automotive applications such as ADAS (Advanced Driver Assistance Systems), high-performance central computing and data rich 3D maps.

Features and Benefits

- Fast boot, auto refresh, manual refresh, enhanced health status
- UFS 3.1 and UFS 2.1 standard interface embedded flash drive for automotive applications
- Capacities up to 512GB[1] in small form-factor BGA
- AEC-Q100/Q104 temperature grade-2 and grade-3
- Automotive SPICE CL3 certified (AT EU552)

Automotive PCIe® NVMe™ SSD

Western Digital **AT EN610** NVMe SSD offers an automotive-grade, high-performance, wide–temperature range storage solution designed for the demanding requirements of next-generation automotive architectures. With flexibility through high-capacity TLC and high-endurance SLC options, the **AT EN610** offers M.2 Type 1620 BGA form factors and up to 1TB of storage space.

Features and Benefits

- PCIe Gen4x4 NVMe 1.4
- SR-IOV with 8 x Virtual Functions
- 32 namespaces TLC and SLC configurable
- Auto refresh, manual refresh, S.M.A.R.T.
- TCG Opal 2.02, support Secure boot, Secure FFU and locking external connections
- Capacities up to 1TB in M.2 Type 1620-S5 BGA per PCI-SIG
- Supports extended temperatures of –40°C to +105°C

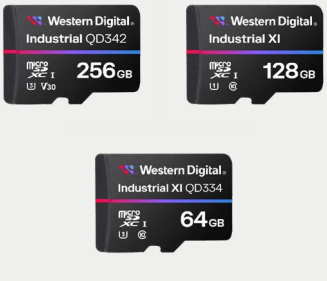
1. One gigabyte (GB) is equal to one billion bytes, one terabyte (TB) is equal to one trillion bytes, and one petabyte (PB) is equal to one quadrillion bytes. Actual user capacity may be less due to operating environment.

Automotive SD Card

Automotive SD cards are ideal for automotive applications that require a removable storage medium such as navigation map data and data/video recorders. Western Digital (SanDisk), as a pioneer in SD cards, has shipped billions of cards and is well known to both retail and commercial customers. Automotive-grade SD cards provide a highly reliable data storage solution to capture and store the vehicle's data.

Features and Benefits

- Auto refresh, manual refresh, health status, host lock
- SD 5.1 specification
- Up to 64GB
- AEC-Q100 temperature grade-3

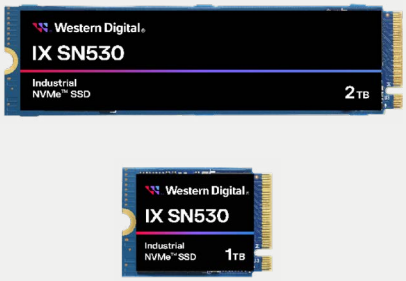


Industrial microSD™ Card

Western Digital also offers extended temperature industrial microSD cards to support customers who not only want a removable solution but also a small form factor. Western Digital offers both SLC and MLC solutions to meet a variety of use cases.

Features and Benefits

- Health status, host lock
- Available in SLC
- Up to 64GB
- Supports extended temperatures of –40°C to +85°C



Industrial PCIe NVMe SSD

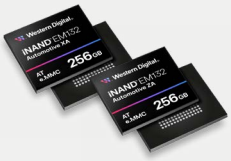
The need for high-capacity solutions continues to increase as the automotive industry develops autonomous vehicles. Capturing and analyzing all of the massive amounts of data from sensors and cameras requires terabytes of storage every day. This data is analyzed to develop better algorithms to make vehicles safer. In addition, the data may be used as evidence in the event of an accident or a legal or an insurance claim.

Features and Benefits

- PCIe Gen3x4 NVMe 1.4
- M.2 2280 and M.2 2230 form factors
- TLC and SLC storage options for high endurance of up to 24 PBW[2]
- High capacities up to 2TB
- Supports extended temperatures of –40°C to +85°C

2. PBW = Petabytes Written. Projected endurance is calculated based on sustained sequential write operation without frequent idle.

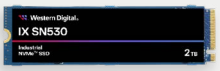
iNAND Automotive Embedded Flash Drives

	 iNAND AT EU312	 iNAND AT EU552	 iNAND AT EM122	 iNAND AT EM132
Product Specification				
Interface	UFS 2.1	UFS 3.1	e.MMC 5.1	e.MMC 5.1
Capacity[1]	16GB to 256GB	64GB to 512GB	8GB to 64GB	32GB to 256GB
Operating temperature	XA: -40°C to +85°C ZA: -40°C to +105°C	XA: -40°C to +85°C ZA: -40°C to +105°C	XA: -40°C to +85°C ZA: -40°C to +105°C	XA: -40°C to +85°C ZA: -40°C to +105°C
NAND flash technology	3D TLC	3D TLC	2D MLC	3D TLC
Package (mm)				
8GB	—	—	11.5x13x0.8mm	—
16GB	11.5x13x1.2mm	—	11.5x13x0.8mm	—
32GB	11.5x13x1.2mm	—	11.5x13x1.0mm	11.5x13x1.0mm
64GB	11.5x13x1.2mm	11.5x13.1.2mm	11.5x13x1.2mm	11.5x13x1.0mm
128GB	11.5x13x1.2mm	11.5x13x1.2mm	—	11.5x13x1.0mm
256GB	11.5x13x1.2mm	11.5x13x1.2mm	—	11.5x13x1.2mm
512GB	—	11.5x13x1.2mm	—	—
Ordering Information				
8GB	—	—	SDINBDG4-8G-XA3 SDINBDG4-8G-ZA3	—
16GB	SDINDDH-16G-XA2 SDINDDH-16G-ZA2	—	SDINBDG4-16G-XA3 SDINBDG4-16G-ZA3	—
32GB	SDINDDH-32G-XA2 SDINDDH-32G-ZA2	—	SDINBDG4-32G-XA3 SDINBDG4-32G-ZA3	SDINBDA6-32G-XA1 SDINBDA6-32G-ZA1
64GB	SDINDDH-64G-XA2 SDINDDH-64G-ZA2	SDINFDQ6-64G-XA1 SDINFDQ6-64G-ZA1	SDINBDG4-64G-XA3 SDINBDG4-64G-ZA3	SDINBDA6-64G-XA1 SDINBDA6-64G-ZA1
128GB	SDINDDH-128G-XA2 SDINDDH-128G-ZA2	SDINFDQ6-128G-XA1 SDINFDQ6-128G-ZA1	—	SDINBDA6-128G-XA1 SDINBDA6-128G-ZA1
256GB	SDINDDH-256G-XA2 SDINDDH-256G-ZA2	SDINFDQ6-256G-XA1 SDINFDQ6-256G-ZA1	—	SDINBDA6-256G-XA1 SDINBDA6-256G-ZA1
512GB	—	SDINFDQ6-512G-XA1 SDINFDQ6-512G-ZA1	—	—

Automotive SD and Industrial microSD Cards

	 Automotive AT LD332	 Industrial Wide Temp IX QD332	 Industrial Ext Temp IX QD332	 Industrial Ext Temp High Endurance IX QD334	 Industrial Wide Temp IX QD342
Interface	UHS-1 104	UHS-1 104	UHS-1 104	UHS-1 104	UHS1-104
Form factor	SD	microSD	microSD	microSD	microSD
Capacity[1]	8GB to 64GB	8GB to 128GB	8GB to 128GB	8GB to 64GB	16GB to 256GB
Operating temperature[3]	–40°C to +85°C	–25°C to +85°C	–40°C to +85°C	–40°C to +85°C	–25°C to +85°C
NAND flash technology	2D MLC	2D MLC	2D MLC	2D SLC	3D TLC
Speed class	C10	C10, U1	C10, U1	C10, U3	C10, U1, U3, V10, V30
Performance R/W[4]	Up to 80/50 MB/s	Up to 80/50 MB/s	Up to 80/50 MB/s	Up to 90/50 MB/s	Up to 100/50 MB/s
8GB	SDSDAG3-008G-XA	SDSDQAF3-008G-I	SDSDQAF3-008G-XI	SDSDQED-008G-XI	—
16GB	SDSDAG3-016G-XA	SDSDQAF3-016G-I	SDSDQAF3-016G-XI	SDSDQED-016G-XI	SDSDQAF4-016G-I
32GB	SDSDAG3-032G-XA	SDSDQAF3-032G-I	SDSDQAF3-032G-XI	SDSDQED-032G-XI	SDSDQAF4-032G-I
64GB	SDSDAG3-064G-XA	SDSDQAF3-064G-I	SDSDQAF3-064G-XI	SDSDQED-064G-XI	SDSDQAF4-064G-I
128GB	—	SDSDQAF3-128G-I	SDSDQAF3-128G-XI	—	SDSDQAF4-128G-I
256GB	—	—	—	—	SDSDQAF4-256G-I

Automotive and Industrial grade SSDs

	 Automotive AT EN610	 Industrial-grade IX SN530	 Industrial-grade IX SN530	 Industrial-grade IX SN530	 Industrial-grade IX SN530
Interface	PCIe Gen4x4 NVMe 1.4	PCIe Gen3x4 NVMe 1.4	PCIe Gen3x4 NVMe 1.4	PCIe Gen3x4 NVMe 1.4	PCIe Gen3x4 NVMe 1.4
Form factor (per PCI-SIG)	M.2 Type 1620-S5 BGA	M.2 2280-S3-M	M.2 2280-S3-M	M.2 2230-S3-M	M.2 2230-S3-M
Capacity[1]	256GB to 1TB	256GB to 2TB	85GB to 340GB	256GB to 1TB	85GB to 340GB
Operating temperature[3]	-40°C to +105°C	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C
NAND flash technology	3D TLC	3D TLC	3D SLC	3D TLC	3D SLC
Performance R/W[5]	Up to 3,700/3,000 MB/s	Up to 2,500/1,800 MB/s	Up to 2,400/1,950 MB/s	Up to 2,400/1,950 MB/s	Up to 2,400/1,950 MB/s
Performance sustain W[6]	Up to 800 MB/s	Up to 540	Up to 1,950 MB/s	Up to 540 MB/s	Up to 1,950 MB/s
Endurance[7] (Projected)	Up to 2,800 TBW(TLC) / 30,000 TBW (SLC)	Up to 5,200 TBW	Up to 24,000 TBW	Up to 2,600 TBW	Up to 24 PBW
256GB (TLC) / 85GB (SLC)	SDDQUGD-256G-ZA	SDBPNPZ-256G-XI	SDBPNPZ-085G-XI	SDBPTPZ-256G-XI	SDBPTPZ-085G-XI
512GB (TLC) / 170GB (SLC)	SDDQUGD-512G-ZA	SDBPNPZ-512G-XI	SDBPNPZ-170G-XI	SDBPTPZ-512G-XI	SDBPTPZ-170G-XI
1TB (TLC) / 340GB (SLC)	SDDQUGD-1T00-ZA	SDBPNPZ-1T00-XI	SDBPNPZ-340G-XI	SDBPTPZ-1T00-XI	SDBPTPZ-340G-XI
2TB (TLC)	—	SDBPNPZ-2T00-XI	—	—	—

3. Operational temperature is defined such as -40°C refers to ambient temperature. 85°C or 105°C refers to SMART composite temperature reported by the drive (when thermal throttling is triggered).
4. Based on Western Digital internal testing. Performance based on e.MMC high speed interface, using an 8-bit bus. Read and write speeds may vary depending on read/write conditions. 1 megabyte (MB) = 1 million bytes.
5. Measured with CrystalDiskMark, 1000MB LBA range, secondary 1TB drive. Sequential: 1T QD32, Random: 8T QD32. Performance may vary based on host device.
6. Sustained performance is measured by FIO 1.97, using 100% LBA range as a secondary drive. Performance may vary based on host device.
7. Endurance is calculated based on sustained sequential write operation without frequent idle.

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Western Digital.

Mouser Electronics

Authorized Distributor

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SanDisk:

SDINFDQ6-128G-XA1 SDINFDQ6-64G-ZA1 SDINFDQ6-256G-XA1 SDINFDQ6-256G-ZA1 SDINFDQ6-512G-XA1 SDINFDQ6-64G-XA1 SDINFDQ6-128G-ZA1 SDINFDQ6-512G-ZA1